General File

Elk Hills Power

P.O. Box 460
Tupman, CA 93276

Tel: (661) 763-2700
Fax: (661) 763-2704

2002
GK

June 18, 2001

Via Federal Express

Mr. George Robin
U.S. Environmental Protection Agency
Ground Water Office (WTR-9)
75 Hawthorne Street
San Francisco, CA 94105

Subject: **DOGGR Information**
Elk Hills Power Project, UIC Permit #CA200002

Dear Mr. Robin:

Per your request, we are forwarding to you copies of the DOGGR correspondence with the Bechtel Petroleum Operations, Inc. about the reasons for surface breakouts in the 7G/18G area. A copy of this correspondence was requested by you during our meeting last Wednesday.

Please do not hesitate to call me if you have any questions.

Sincerely,

Raymond Kelly
Permitting Manager

Attachments

Cc: Joe Risse, SER w/o Attachments
Donna Thompson, SJEC w/o Attachments
Barry Hanson, SPS w/o Attachments
Taylor Miller, Sempra Energy w/o Attachments

H:/Kelly/ElkHills/L-GR_UIC Well Constr Submittals.doc

to thirteen months following the injection pressure drop. The length of time the MASP was exceeded also varied considerably from barely one month to twenty-eight out of the preceding eighty-four months. The pressures over MASP ranged from less than 10 psi to 95 psi with the average being approximately 20 psi.

3) In section 18G, only one first occurrence of surface breakthrough took place following a noticeable overpressuring period (well 81WD-18G). The other two wells (61WD-18G) and (71WD-18G) had first incidents occur 8 - 10 months following possible minor (<5 psi) exceedance of the MASP. It should be noted that the surface discharge of well 81WD-18G occurred less than one month following the exceedance. Injection volumes were below normal or declining on two of the wells.

(It should be noted that many of these wells exceeded the MASP for years prior to the first recorded surface breakthrough. Whether this indicates that pressure is not a factor in these occurrences or whether either breakthroughs occurred which weren't discovered or documented is unknown).

4) Geologically, the Tulare formation outcrops essentially uniformity in all three areas. In section 24Z, past injection reportedly was primarily in intervals shallower than those in sections 7G and 18G. The regional dip in all areas is to the SSW. Topographically, the seeps directly relatable to a specific well appear to be essentially the same elevation as the well but all are up-dip structurally. Fracturing, where evident, appears to be perpendicular to strike.

Based upon these observations, the following conclusions have been reached by this Division:

1) Formation damage may have occurred due to overpressuring and possible fracturing of the formation prior to the first recorded surface breakthrough. Injection pressures above the maximum allowable gradient of 0.8 psi/ft have been reported on all wells except, possibly, wells 61WD-18G and 71WD-18G. In some cases, particularly section 24Z, these pressures were considerably (over 100 psi) above the MASP and were maintained at these elevated pressures for many months or years prior to the first breakthrough occurrence.

2) Injection rates may also be a contributing factor, primarily in instances where the injection well spacing was close enough to result in interference, thus causing a change in both the well operation (reduced rates, increased pressures) and the subsurface fluid dynamics (change in fluid movement direction).

3) Due to lower pressures, higher permeability and the absence of interstitial fluid, the shallower Tulare sands could reasonably be expected to "fill up" as a result of injection, even in the up-dip direction. Surface breakthrough in areas where the injection sand(s) outcrop at the surface would be a natural possibility.

4) The reported lack of injection fluid "cleaning" processes could also contribute to the events observed. Oil, grease and other solids in the injectate commonly cause perforation and/or formation plugging which results in higher injection pressures which could create artificial fractures and channelling of the fluid.

5) In the section 24Z area, observed fractures have reportedly been related to the surface breakthroughs documented. Whether these fractures are naturally occurring or a result of the overpressuring described earlier are uncertain.

In summary, this Division feels that the surface breakthrough of Tulare zone injection fluid in Elk Hills field is a result of several contributing factors. Excessive injection pressures above the 0.8 psi/ft gradient permitted may have caused formation damage and fracturing. The close proximity of injection wells probably resulted in flood-front interference which promulgated up-dip movement into low-pressure, desaturated, higher permeability sands which outcrop. Increases in injection volumes, even if not associated with increases in injection pressures, could similarly result in up-dip migration (i.e., fill-up) and ultimate surface breakthrough where the on-strike or down-dip formation was incapable of accepting those volumes.

It is therefore this Division's determination that:

1. Surface injection pressures on all Tulare zone injection wells shall be restricted to a 0.8 psi/ft gradient;

2. Injection well spacing shall be designed to prevent, as best as possible, interference effects due to disposal operations which could result in up-dip movement and potential surface breakthrough of the injection fluid;

3. Injection volumes shall be monitored on at least a monthly basis to ensure that up-dip formation fill-up does not occur in those wells whose injection intervals outcrop at the surface;

4. Should any evidence of surface breakthrough of injection fluid be discovered, this Division shall be notified immediately. The cause of the incident (known or suspected), the date, time and place of occurrence, and the actions being taken to stop the problem and prevent its reoccurrence shall be required as part of the

notification. Any such event may result in additional restrictions and/or rescission of injection.

5. Your decision to cease all injection into the section 24Z disposal wells, while supported by this Division, is not ordered by this Division provided the aforementioned requirements are met.

Should you have any questions, please contact this office.

Yours truly,

David Mitchell
Senior Oil and Gas Engineer

DM/njk